#13/ME
12/4/02

DECLARATION

I, Manami Enomoto, a staff member of TAIYO, NAKAJIMA & KATO, Seventh Floor, HK-Shinjuku Bldg., 3-17, Shinjuku 4- chome, Shinjuku-ku, Tokyo 160-0022, Japan, do hereby declare that I am well acquainted with the English and Japanese languages and I hereby certify that, to the best of my knowledge and belief, the following is a true and correct translation made by me into the English language of the accompanying copies of the documents in respect of Japanese Patent Application No.11-43208 filed on 22nd February 1999 in the name of BRIDGESTONE CORPORATION.

Dated this 19th day of November, 2002

Manami Enomoto

Manami Enomoto

[DOCUMENT NAME]	Application for Patent
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[DOCUMENT]	Specification 1
[DOCUMENT]	Drawings 1
[DOCUMENT]	Abstract of the Disclosure 1
[GENERAL POWER OF ATTORNEY NUMBER]	9705796

[DOCUMENT NAME] SPECIFICATION

[TITLE OF THE INVENTION]

PNEUMATIC TIRE

[CLAIMS]

[Claim 1] A pneumatic tire in which a plurality of blocks demarcated by circumferential grooves extending in a circumferential direction of the tire and grooves intersecting the circumferential grooves, are provided on a tread,

wherein at least a portion of a block edge is chamfered from the side of a block center to a groove wall surface of each of the blocks;

a heightwise cross sectional form of a chamfer portion perpendicular to the groove wall surface is formed by a combination of a plurality of chamfer forms; and

an angle formed by a tangential line of the chamfer portion with respect to a horizontal extension line of the surface of the block center in a heightwise cross section perpendicular to the groove wall surface increases from the side of the block center to the side of the block end.

[Claim 2] A pneumatic tire according to claim 1, wherein the cross sectional form of the chamfer portion is provided such that a portion of the cross sectional form of the chamfer portion on the block central side is formed as a straight line portion and a portion of the cross sectional form of the chamfer portion on the block end side is formed by at least one curved line portion having a fixed curvature.

[Claim 3] A pneumatic tire according to claim 1 or 2, wherein the cross sectional form of the chamfer portion is comprised of two curved line portions having different curvatures.

[Claim 4] A pneumatic tire according to any one of claims 1 through 3, wherein when in the heightwise cross section perpendicular to the groove wall surface, a length of the chamfer portion measured along a horizontal extension line of the surface of the block central portion is represented by L1 and a likewise measured length of the block is represented by L0, the ratio L1/L0 is in the range from 0.02 to 0.30.

[Claim 5] A pneumatic tire according to any one of claims 1 through 4, wherein a distance, measured along a radial direction of the tire, between the horizontal extension line of the surface of the block central portion and an intersection point of the chamfer portion and the groove wall surface is in the range from 0.10 to 2.50 mm.

[Claim 6] A pneumatic tire according to any one of claims 1 through 5, wherein when a heightwise distance between a groove bottom of the block and the intersection point of the chamfer portion and the groove wall surface is represented by H1 and the maximum height of the block is represented by H0, the ratio H1/H0 is in the range from 0.70 to 0.99 mm.

[Claim 7] A pneumatic tire according to any one of claims 1 through 6, wherein the cross sectional form of the chamfer portion changes at a peripheral edge of the block for each portion of the block.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Technical Field of the Invention]

The present invention relates to a pneumatic tire improved in handling stability.

[0002]

[Prior Art]

In conventional pneumatic tires, normally, the height of each block is fixed. The block 100 deforms (at the time of running) as shown in Fig. 6B, and a ground contact pressure of a tread surface 102 becomes ununiform (that is, the ground contact pressure becomes higher at ends of the block; see Fig. 6A). Therefore, it becomes difficult that braking force or driving force be transmitted from the entire tread surface 100 to a road surface 104. A portion of the block 100 is worn down in an early stage due to the ununiformity of ground contact pressure, that is, uneven wear is apt to occur. Further, when shear stress caused by local concentration of ground contact pressure is input, only a region in the vicinity of a ground contact end of the block 100 at an input side of shear stress contacts the road surface locally in high pressure, and the tread surface 102 is turned up (see Fig. 7). As a result, the handling stability of tires is adversely

affected.

[0003]

In order to improve ground contact characteristics of tires, improvements of a tread pattern and the like have conventionally been made. However, under the existing circumstances, there is a limit to the improvement because the aspect of water drainability or the relationship with other various characteristics must be considered simultaneously.

[0004]

Further, there has also been made an improvement in which a region in the vicinity of the ground contact end of the block is chamfered for the purpose of making the ground contact pressure uniform. For example, it is general that an end 106 in which the ground contact pressure concentrates be tapered as shown in Fig. 8 or be chamfered substantially in an R-shaped manner as shown in Fig. 9. In order that the ground contact pressure be made uniform by chamfering the block in an R-shaped manner, it is not necessary that the R-shaped curved surface be tangent to a groove surface 108 at the ground contact end of the block. Accordingly, it is known that chamfering in which an R-shaped curved surface only tangent to the ground contact surface is provided as shown in Fig. 10, is very effective.

[0005]

However, since a single curvature is used in the above-described

chamfers, the effect of equalizing the ground contact pressure is not sufficiently obtained, although the ground contact pressure at the end of the block is reduced. It is necessary for the purpose of further improvement in handling stability that the shape of the chamfer faithfully corresponds to the ground contact pressure distribution.

[0006]

[Problems to be Solved by the Invention]

It is therefore an object of the present invention to provide a pneumatic tire in which ununiformity of ground contact pressure is prevented by defining a proper height of each block on the tread pattern, and handling stability and uneven wear resistance are improved.

[0007]

[Means for Solving the Problems]

In order to solve the above-described problems, the invention described in claim 1 is a pneumatic tire in which a plurality of blocks demarcated by circumferential grooves extending in a circumferential direction of the tire and grooves intersecting the circumferential grooves, are provided on a tread, wherein at least a portion of a block edge is chamfered from the side of a block center to a groove wall surface of each of the blocks; a heightwise cross sectional form of a chamfer portion perpendicular to the groove wall surface is formed by a combination of a plurality of chamfer forms; and an angle formed by a tangential line of the chamfer portion with respect to a horizontal

extension line of the surface of the block center in a heightwise cross section perpendicular to the groove wall surface increases from the side of the block center to the side of the block end.

[0008]

An operation of the pneumatic tire described in claim 1 will be described.

[0009]

As illustrated in Fig. 6A, the ground contact pressure distribution of each of blocks formed on a tread gradually increases from a central portion to ends of the block and becomes high locally at the ends. It was considered from the above-described fact that an angle of inclination (including a curvature) of the chamfer portion be preferably made larger toward the end of the block as shown in Fig. 1. The "angle of inclination" mentioned herein is an angle formed by an extension line of the surface at the central portion of the block tread surface in a cross sectional form of the block with respect to a tangential line of the chamfer portion.

[0010]

Due to the above-described structure or due to a combination of a plurality of chamfer forms, correction of the ground contact pressure corresponding to ununiformity of the ground contact pressure, which conventionally could not be corrected, becomes possible, and the ground

contact pressure on the block tread surface can be equalized further. As a result, handling stability of the tire improves.

[0011]

The invention described in claim 2 is characterized in that, in the invention described in claim 1, the cross sectional form of the chamfer portion is provided such that the block central side thereof (a portion of the cross sectional form of the chamfer portion on the block central side) is formed as a straight line portion and the block end side thereof (a portion of the cross sectional form of the chamfer portion on the block end side) is formed by at least one curved line portion having a fixed curvature.

[0012]

An operation of the invention described in claim 2 will be described.

[0013]

In the above-described structure, a portion of the block in which the ground contact pressure does not change so much (that is, the side of the center of the block) is formed as a straight line (a fixed angle of inclination) portion and a portion of the block in which the ground contact pressure changes greatly (that is, the side of the block end) is formed by at least one curved line portion having a fixed curvature. Therefore, although it is a simple structure, the ground contact pressure

can be equalized.

[0014]

The invention described in claim 3 is characterized in that, in the invention described in claim 1 or claim 2, the cross sectional form of the chamfer portion is comprised of two curved line portions having different curvatures.

[0015]

An operation of the invention described in claim 3 will be described.

[0016]

Due to the above-described structure, the side of the center of the block in which the ground contact pressure does not change so much, and the side of the block end in which the ground contact pressure changes greatly, are formed by two curved line portions having different curvatures. Therefore, in spite of a simple structure, equalization of the ground contact pressure can be accomplished. Further, when the side of the center of the block is formed as a straight line portion, only the side of the block end can be formed by two curved line portions having different curvatures. As a result, the ground contact pressure can be equalized still more.

[0017]

The invention described in claim 4 is characterized in that, in the invention described in any one of claims 1 to 3, when in the heightwise cross section perpendicular to the groove wall surface, a length of the chamfer portion measured along a horizontal extension line of the surface of the block central portion is represented by L1 and a likewise measured length of the block is represented by L0, the ratio L1/L0 is in the range from 0.02 to 0.30.

[0018]

An operation of the invention described in claim 4 will be described.

[0019]

When L1/L0 is less than 0.02, an effect of equalizing the ground contact pressure of the block tread surface by the chamfer portion is small. On the other hand, when L1/L0 is more than 0.30, the area of the central portion of the block decreases and there is a possibility that the handling stability may be deteriorated. Accordingly, it is preferable that L1/L0 is in the range from 0.02 to 0.30.

[0020]

The invention described in claim 5 is characterized in that, in the invention described in any one of claims 1 to 4, a distance, measured along a radial direction of the tire, between the horizontal extension line of the surface of the block central portion and an intersection point of the

chamfer portion and the groove wall surface is in the range from 0.10 mm to 2.50 mm.

[0021]

An operation of the invention described in claim 5 will be described.

[0022]

When the distance measured, along a radial direction of the tire, between an extension line of the surface of the block central portion and an intersection point of the chamfer portion and the groove wall surface is less than 0.10 mm, an effect of equalizing the ground contact pressure by the chamfer portion is small. On the other hand, when the distance is greater than 2.50 mm, the ground contacting area decreases and the handling stability of the tire is deteriorated.

[0023]

The invention described in claim 6 is characterized in that, in the invention described in any one of claims 1 to 5, when a heightwise distance between a groove bottom of the block and the intersection point of the chamfer portion and the groove wall surface is represented by H1 and the maximum height of the block is represented by H0, the ratio H1/H0 is in the range from 0.70 mm to 0.99 mm.

[0024]

An operation of the invention described in claim 6 will be described.

[0025]

When H1/H0 is less than 0.70, the ground contacting area decreases and the handling stability of the tire is deteriorated. On the other hand, when the H1/H0 is 0.99 or more, an effect of equalizing the ground contact pressure by the chamfer portion is small.

[0026]

The invention described in claim 7 is characterized in that, in the invention described in any one of claims 1 to 6, the cross sectional form of the chamfer portion changes at a peripheral edge of the block for each portion of the block.

[0027]

An operation of the invention described in claim 7 will be described.

[0028]

The distribution of ground contact pressure between ends of the block varies depending on the measured direction (i.e., in the circumferential direction of the tire or in the transverse direction of the tire) or depending on the distance from a corner of the block. Accordingly, due to the shape of the chamfer portion provided to

correspond to the distribution of ground contact pressure being changed at a peripheral edge of the block, the ground contact pressure on the tread surface is equalized further.

[0029]

[Embodiments]

A pneumatic tire according to an embodiment of the present invention will be described in detail. Referring to Figs. 1 to 4, the embodiment will be described.

[0030]

As illustrated in Fig. 2, a pneumatic tire 10 includes a cylinder-shaped tread 12 extending between a pair of side walls (not shown) disposed parallel to each other. The tread 12 comprises a plurality of main grooves 14 formed along a circumferential direction of the tire (that is, the direction indicated by arrow P), and a plurality of lug grooves 16 formed along a transverse direction of the tire (that is, the direction indicated by arrow W). A plurality of blocks 18 are demarcated by the main grooves 14 and the lug grooves 16.

[0031]

These blocks 18 are each formed substantially into a rectangular parallelepiped in which a tread surface 20 is a square whose lengths in transverse and circumferential directions of the tire are equal to each other.

[0032]

An end on the tread surface 20 of the block 18 is chamfered (a portion subjected to chamfering is hereinafter referred to as a chamfer portion 24). A cross sectional form (of only the end of the block 18 and the vicinity thereof) of the block 18 in a direction oriented from a groove wall surface 22 tangent to the chamfer portion 24 of the block 18 toward a side wall opposite to the groove wall surface 22 so as to be substantially perpendicular to the groove wall surface 22, is shown in Fig. 1. As described above, the cross sectional form of the chamfer portion 24 is formed in such a manner that a curvature of the chamfer portion 24 gradually increases from a central side of the block 18 to the groove wall surface 22 in the vicinity of the end of the block 18 (that is, an angle of inclination θ is made larger). Particularly, the curvature of the chamfer portion 24 is remarkably increased in the vicinity of the groove wall surface 22.

[0033]

A portion at the center of the tread surface 20 in the block 18, which is not chamfered, is hereinafter referred to as a central portion 21.

[0034]

Operations of the pneumatic tire 10 having the above-described structure will be described hereinafter.

[0035]

That is, the chamfer portion 24 is formed such that the curvature thereof gradually increases toward the vicinity of the groove wall surface 22 (see Fig. 6B) in which the ground contact pressure remarkably increases (see Fig. 6A). Therefore, an amount by which the ground contact pressure is suppressed increases toward the vicinity of the groove wall surface 22 at which the ground contact pressure becomes maximum, and the ground contact pressure on the tread surface 20 is equalized.

[0036]

It is, however, ideal but complicated that a subtle change of the curvature as represented by various functions be realized by a finished product. Accordingly, there is considered a simplified structure in which a block-center side 24A and a block-end side 24B (near the groove wall surface 22) in the chamfer portion 24 are chamfered in different ways.

[0037]

There can be provided the following methods in this case:
(1) the chamfer (contour) form (cross sectional form) of the block is provided by continuously forming two types of tapers in which an angle of inclination θ of the block-end side 24B is larger than that of the block-center side 24A (see Fig. 3);
(2) the chamfer form of the block is provided by continuously forming

the block-center side 24A formed as a taper, and the block-end side 24B formed as an R-shaped curved line, that is, a curved line having a fixed curvature (see Fig. 4); and
(3) the chamfer form of the block is provided by continuously forming the block-center side 24A formed as a curved line having a radius of curvature R1, and the block-end side 24B formed as a curved line having a radius of curvature R2 (R1>R2) (see Fig. 5).

Among the above-described methods, it is desired that the methods (2) and (3) be used from the standpoint of equalization of ground contact pressure in the end of the block and the vicinity thereof.

[0038]

In order to ascertain the above-described operational effects, a handling stability test was conducted.

[0039]

Tires used for the test were radial tires whose size was 205/55R16. As illustrated in Fig. 2, a tread pattern of each tire is a combination of squares. The block size was 30 mm×30 mm and the height of the block was 10 mm.

[0040]

First, in order to ascertain effects of the chamfer form, pneumatic tires of the following examples were used:
Example 1: a chamfer form formed by a taper portion and an R-shaped

curve (see Fig. 4)

Example 2: a chamfer form formed by curved lines having radii of curvature R1 and R2 (R1>R2) (see Fig. 5)

Conventional example 1: no chamfer formed

Conventional example 2: a taper portion formed (see Fig. 8)

Conventional example 3: a chamfer form formed by an R-shaped curve only tangent to a ground contact surface of the block (see Fig. 10)

It is desirable that in Examples 1 and 2, the two curved lines be continuously connected to each other with a common tangent line at an intersection point. However, for the purpose of equalizing overall dimensions of the chamfer as far as possible, an approximate value which is close to a tangent continuous state is selected in this case. Detailed dimensions are shown in Table 1. A feeling evaluation was conducted with a vehicle to which the above-described tires were mounted and which was run by an experienced driver on a test course road. The evaluation was made as an index with the result of the tire of the conventional example 1 being 100. The higher the index, the better the feeling evaluation. L0 indicates a transverse dimension of the block along the cross sectional direction, L1 indicates a transverse dimension of the block along the cross sectional direction from the groove wall surface 22 to a boundary between the chamfer portion 24 and the central portion 21. H0 indicates the height of the block and H1 indicates a height at an intersection point of the chamfer portion 24 and the groove wall surface 22. The "height" mentioned herein means a dimension measured from the bottom of the main groove 14.

[0041]

[Table 1]

TABLE 1

	Chamfer form Block-center side	Chamfer form in a peripheral portion of block	L1/LO	H1/H0	H1	Score Of Evaluation
Example 1	Straight line (0.5 mm chamfered in 4mm)	R4.0	0.2	0.85	1.5	115
Example 2	R16.25	R4.0	0.2	0.85	1.5	122
Conventional Example 1	-----	-----	-----	-----	-----	100
Conventional Example 2	Straight line (1.5mm chamfered in 6mm)	←	0.2	0.85	1.5	108
Conventional Example 3	R12.75	←	0.2	0.85	1.5	109

[0042]

Next, in order to ascertain the difference in the effect based on the length L1 in the cross sectional direction to be chamfered in the case of "R1+R2" in which the most excellent effect was obtained (Example 2), Examples 1-1 to 1-5 and Conventional example 1-1 (no chamfer formed) were compared. The same testing method and evaluation method are used. The test results are shown in Table 2.

[0043]

[Table 2]

TABLE 2

	L1/L0	Score of evaluation
Example 1-1	0.01	106
Example 1-2	0.02	112
Example 1-3	0.15	122
Example 1-4	0.29	114
Example 1-5	0.31	107
Conventional Example 1-1	-----	100

Fixed condition:

H1/H0	H1
0.85	1.5

[0044]

Further, in order to ascertain a desired height of chamfer in the case of "R1+R2", Examples 2-1 to 2-5 and Conventional Example 2-1 (no chamfer formed) were compared. The same testing method and evaluation method are used. The test results are shown in Table 3.

[0045]

[Table 3]

TABLE 3

	H0-H1	H1/H0	Score of evaluation
Example 1-1	9.95	0.995	102
Example 1-2	9.90	0.990	112
Example 1-3	8.75	0.875	122
Example 1-4	7.50	0.750	112
Example 1-5	7.40	0.740	109
Example 1-6	7.00	0.700	103
Example 1-7	6.80	0.680	97
Conventional Example 1	-----	-----	100

Fixed conditions:

L1/L0: 0.2 (two types of R: radius of curvature)

[0046]

It can be seen from Table 1 that the chamfer form proposed by the present invention, which approximates to an actual ground contact pressure distribution, be effective. Although the conventional chamfered structure improves the performance as compared with no chamfer structure, the above-described evaluation was conducted assuming the desired standard in this case being 110 or greater, which greatly differs from the conventional examples.

[0047]

A preferred chamfer dimension is determined based on the above-described standard. The block size varies for each block pattern. It is preferable from Table 2 that a chamfer length L1 be 0.02 to 0.30 with the cross sectional length L0 of the block (along the transverse direction of the tire) being 1. Further, it is desired from Table 3 that the height of

chamfer (H0-H1) be 0.1 to 2.5 mm. Furthermore, a desired effect can be recognized when the height position of the intersection point of the chamfer portion 24 and the groove wall surface 22 is approximately 0.7 or greater with respect to the height of the block being 1. Moreover, even if an amount of chamfer is small (even if the height position of the intersection point is 0.995), the effect of an improvement in the handling stability is obtained. The height position of the intersection point is more preferably 0.750 to 0.990.

[0048]

[Effect of the Invention]

As described above, in the pneumatic tire relating to the present invention, the ground contact pressure of the tread surface can be made uniform, and the handling stability of the tire is greatly improved.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[Fig. 1]

Fig. 1 is a cross sectional view showing an end of a block and the vicinity thereof according to an embodiment of the present invention.

[Fig. 2]

Fig. 2 is a plan view of a tread according to the embodiment of the present invention.

[Fig. 3]

Fig. 3 is a cross sectional view showing an end of a block and the vicinity thereof according to another example of the present invention.

[Fig. 4]

Fig. 4 is a cross sectional view showing an end of a block and the vicinity thereof according to still another example of the present invention.

[Fig. 5]

Fig. 5 is a cross sectional view showing an end of a block and the vicinity thereof according to still yet another example of the present invention.

[Fig. 6]

(A) is a diagram showing ground contact pressure distribution in a conventional pneumatic tire.

(B) is a diagram showing a deformed block in the conventional pneumatic tire.

[Fig. 7]

Fig. 7 is a diagram showing a deformation state of a block in the conventional pneumatic tire.

[Fig. 8]

Fig. 8 is a cross sectional view showing an end of a block and the vicinity thereof in a conventional example.

[Fig. 9]

Fig. 9 is a cross sectional view showing an end of a block and the vicinity thereof in another conventional example.

[Fig. 10]

Fig. 10 is a cross sectional view showing an end of a block and the vicinity thereof in still another conventional example.

[Description of the Reference Numerals]

10: pneumatic tire

12: tread

14: main grooves (formed along a circumferential direction of the tire)

16: lug grooves (formed along a transverse direction of the tire)

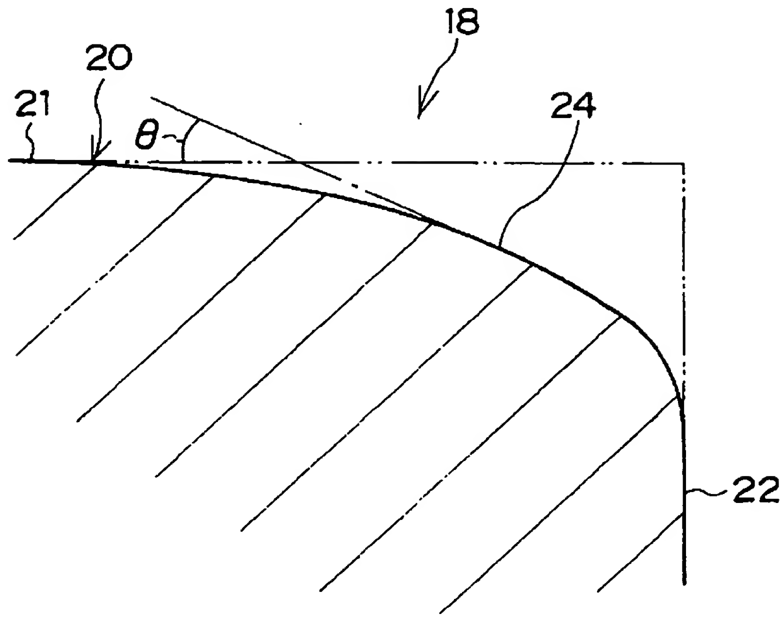
18: block

21: central portion

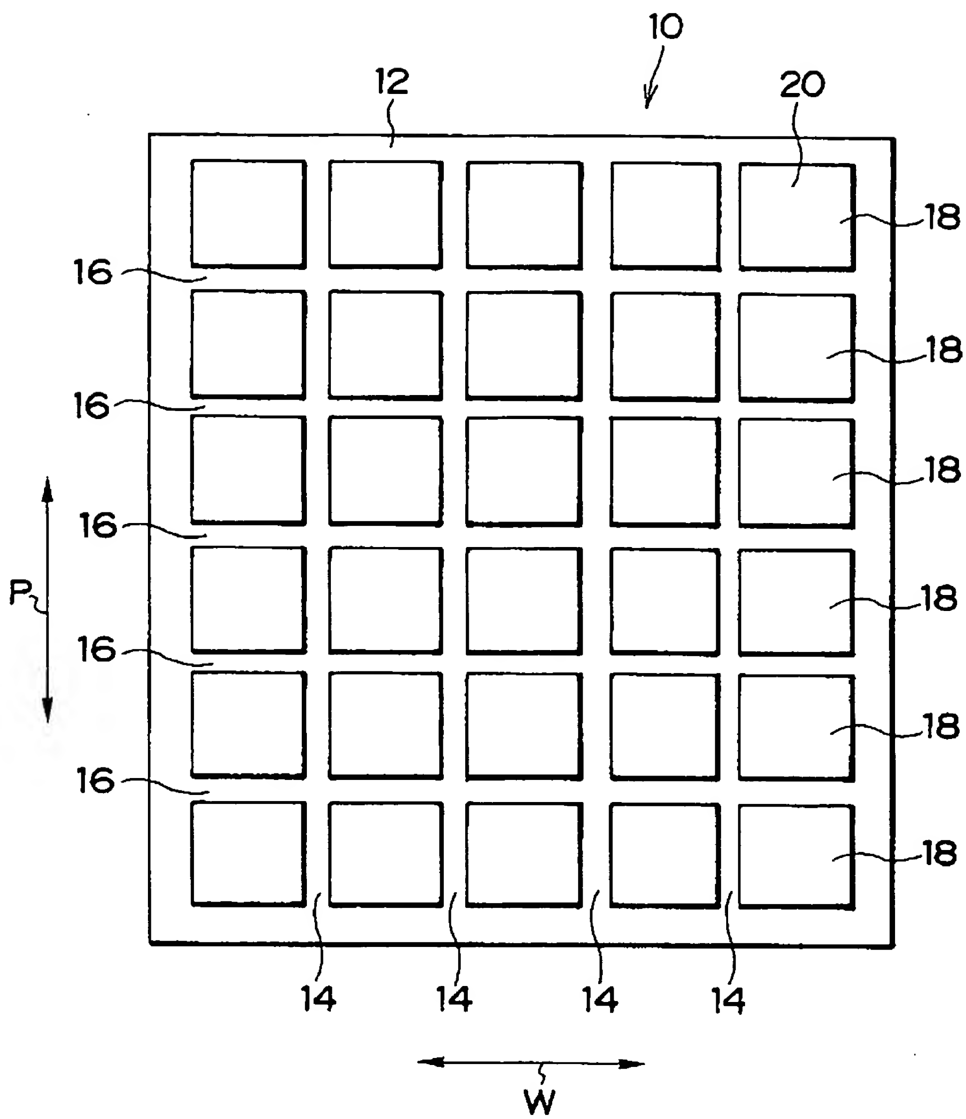
24: chamfer portion

[DOCUMENT NAME] DRAWINGS

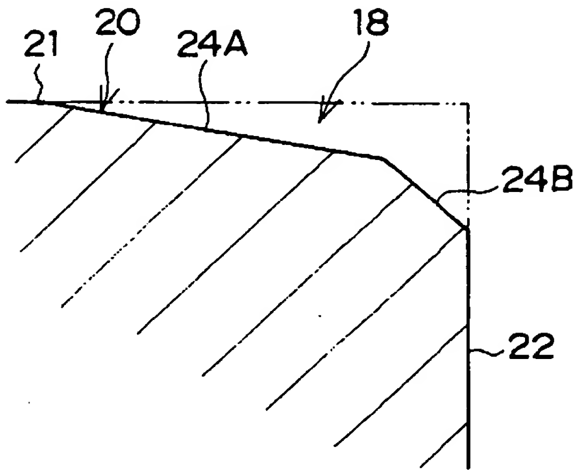
[FIG. 1]



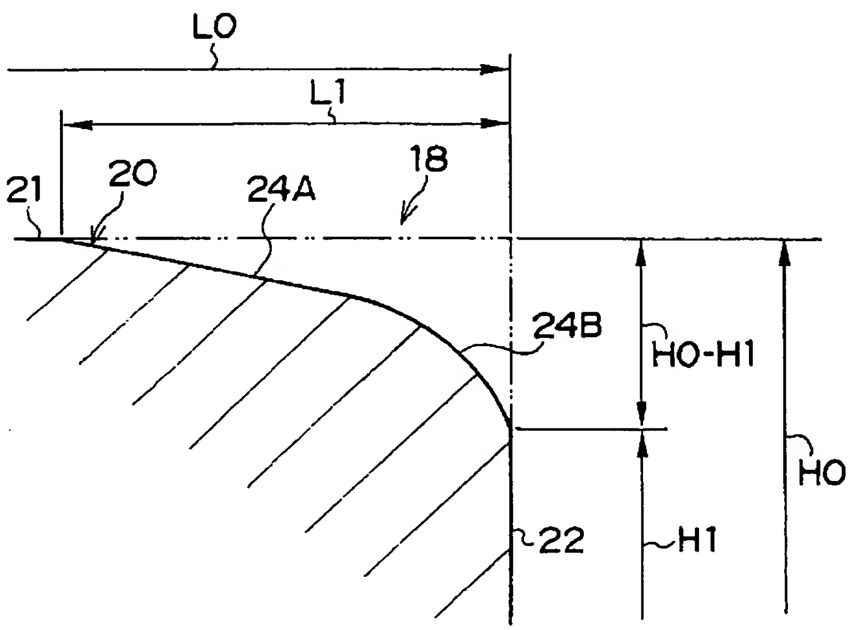
[FIG. 2]



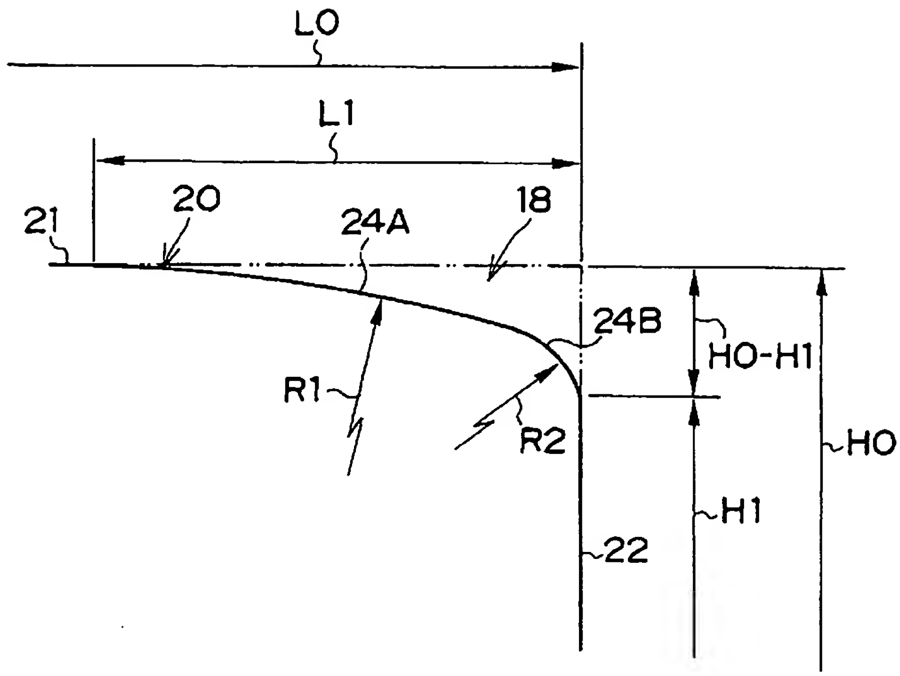
[FIG. 3]



[FIG. 4]

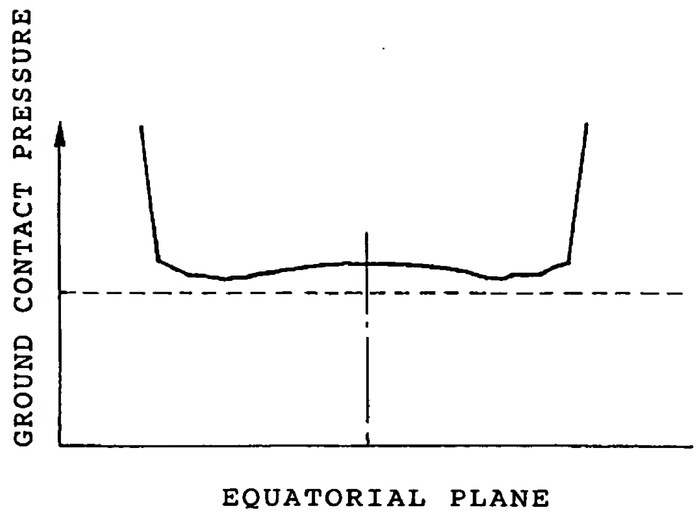


[FIG. 5]

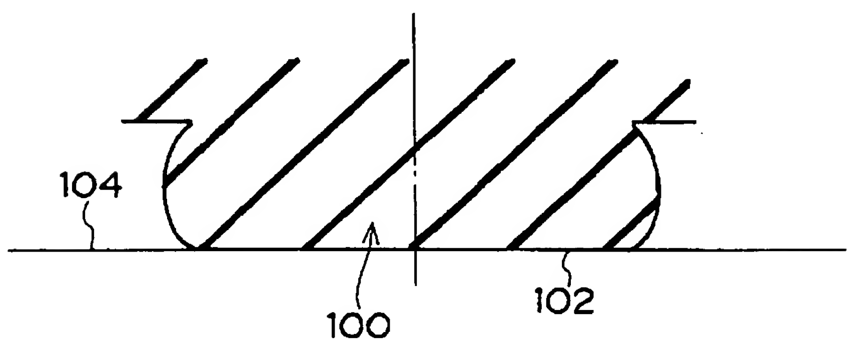


[FIG. 6]

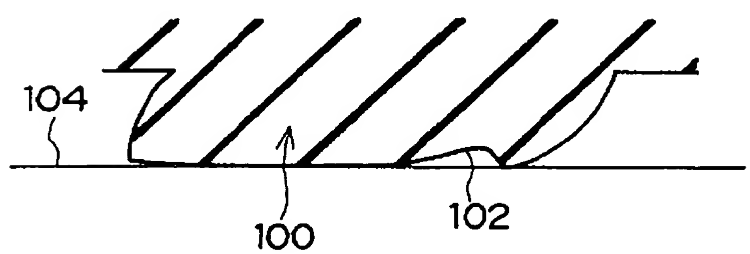
(A)


GROUND CONTACT PRESSURE
EQUATORIAL PLANE

(B)


104
100
102

[FIG. 7]


104
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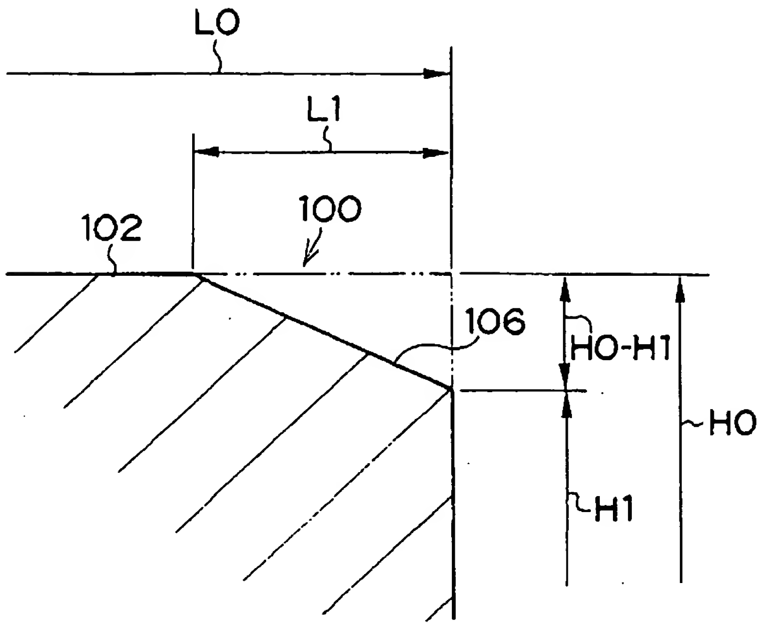
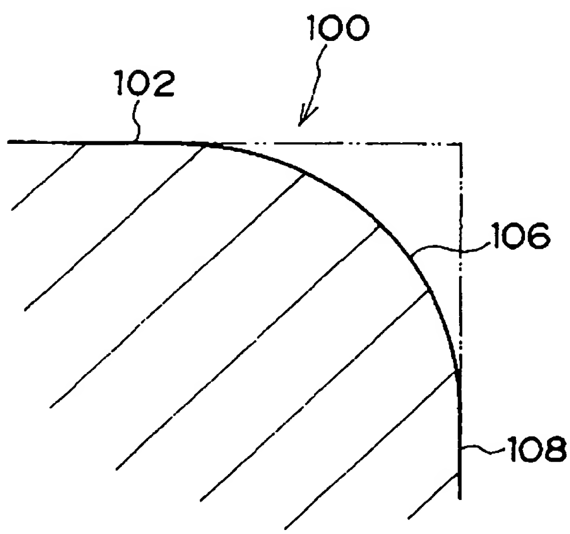
102

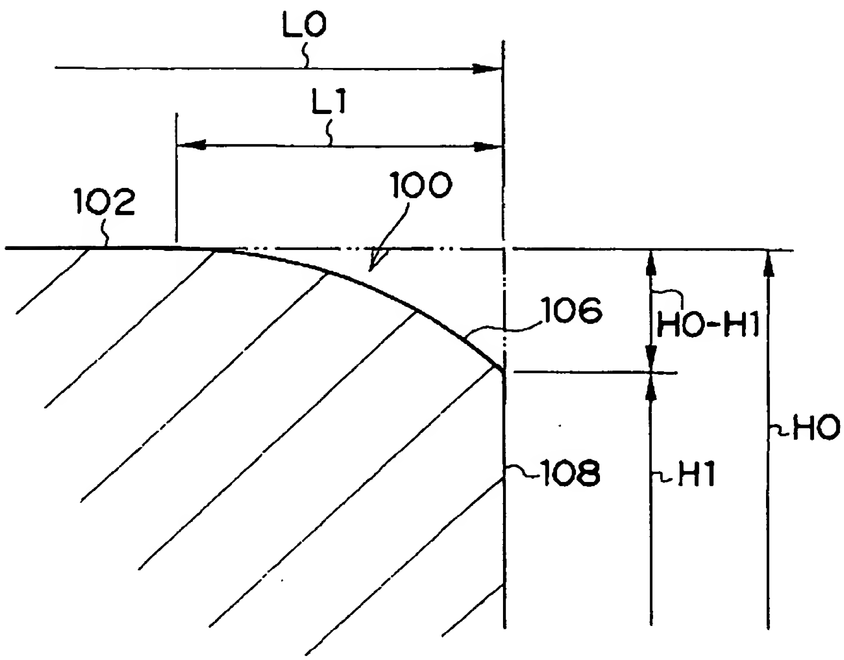
[FIG. 8]



[FIG. 9]



[FIG. 10]



[DOCUMENT NAME] ABSTRACT OF THE DISCLOSURE

[SUMMARY]

[PROBLEM TO BE SOLVED]

To provide a pneumatic tire having improved handling stability.

[MEANS TO SOLVE THE PROBLEM]

An end of a block 18 formed on a tread surface of a tire is chamfered in such a manner that a curvature of a chamfer increases toward the end of the block. Accordingly, a ground contact pressure which usually increases locally at the end of the block 18 is equalized and handling stability of the tire improves. Particularly, since the curvature changes, the ground contact pressure can be controlled corresponding to an actual distribution of ground contact pressure. As a result, the ground contact pressure can be equalized still further and an improvement in handling stability of the tire is achieved.

[SELECTED FIGURE]

Fig. 1